

count number of rostellar hooks in our specimens Honda (1939) noted that there were 80. *Raillietina* sp. of Goto and Nishimura (1988) shows similar measurements to Honda's (1939) and ours; thus, it may also be identified as *R. coreensis*.

Though both Miyazaki (1950) and Kamiya et al. (1968) reported *Raillietina* from *Rattus* in southern parts of Japan, specimens of ours and of Goto and Nishimura (1988) from *Apodemus* were obtained in the far north of the country. It suggests that cestodes in *Apodemus* have a different distribution and host range than those in *Rattus*. Including this study, *R. coreensis* has been reported from 2 species of *Apodemus*. We suggest that *R. coreensis* has a close host-parasite relationship with *Apodemus* in east Asia.

This work was supported by a grant from the Ministry of Education, Science and Culture, Japan (No. 03044016).

J. Helminthol. Soc. Wash.
61(2), 1994, pp. 240-244

Research Note

Helminth Parasites of Ringed Seal, *Phoca hispida*, from Northern Quebec, Canada

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ABSTRACT: Five ringed seals, *Phoca hispida* Schreber, 1775 collected by Inuit hunters near Salluit (Quebec) in eastern Arctic Canada were examined for helminths. Four nematodes, *Acanthocheilonema spirocauda* (Leidy, 1858), *Otostrongylus circumlitus* (Railliet, 1899), *Filaroides* (*Parafilaroides*) *krascheninnikovi* Yurakhno and Skrjabin, 1971, and *Phocascaris phocae* Höst, 1932; 2 acanthocephalans, *Corynosoma strumosum* (Rudolphi, 1802) and *C. reductum* (von Linstow, 1905); 2 cestodes, *Diplogonoporus tetraapterus* (von Siebold, 1848) and *Anophryocephalus* sp., were found. New geographic records of *A. spirocauda*, *P. krascheninnikovi*, *P. phocae*, and *D. tetraapterus* are reported.

KEY WORDS: parasitic helminths, ringed seal, *Phoca hispida*, Arctic Canada, *Acanthocheilonema spirocauda*, *Otostrongylus circumlitus*, *Filaroides* (*Parafilaroides*) *krascheninnikovi*, *Phocascaris phocae*, *Corynosoma strumosum*, *Corynosoma reductum*, *Diplogonoporus tetraapterus*, *Anophryocephalus* sp.

The ringed seal, *Phoca hispida* Schreber, is still an important "country food" in some Inuit com-

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munities in Arctic Canada. It is the most common and most widely distributed Arctic seal and has a circumpolar distribution. Its helminth fauna in eastern Arctic Canada has been poorly studied (Cooper, 1921; Lyster, 1940; Myers 1957a, b). Recently, Kennedy (1986) and Onderka (1989) studied lungworms of ringed seals in western Arctic Canada. During some preliminary work with ringed seals in northern Quebec various helminths were collected and the present study reports our findings.

Five ringed seals were collected by Inuit hunters in inshore waters of Hudson Strait near Salluit (Quebec), Canada (62°13'N, 75°39'W) 25-28 August 1992. From each animal standard length, axial girth, maximum girth, blubber thickness, body weight, and sculp weight were measured (American Society of Mammalogists, 1967). Sculp weight is the weight of the skin with

attached blubber dissected from the body beginning at the proximal end of the hind flippers to a point midway between the eyes and external ear openings. The lower jaw was collected for determination of age. Thin transverse sections of canine teeth were cut and growth layers counted with transmitted light (McLaren, 1958). Four of five ringed seals examined were young-of-the-year (YOY). They were probably 4–5 mo old as ringed seals give birth in March or April in eastern Arctic Canada (McLaren, 1958; Smith, 1973). The stomachs of all ringed seals were full and contained crustaceans identified as *Mysis oculata* (O. Fabricius, 1780). The lungs, trachea, heart, stomach, and intestine were examined for helminths. The muscle and other organs and tissues were kept by the hunters. Nematodes were fixed in hot 10% glycerin–alcohol (9 parts 70% alcohol: 1 part glycerin) and cleared by evaporation. Acanthocephalans and cestodes were fixed in 10% buffered formalin and stained with Semichon's acetocarmine (Pritchard and Kruse, 1982). Thick transverse sections of some cestode proglottids were made by hand using a razorblade. Measurements and morphological study of helminths were made using a Leitz Diaplan microscope equipped with a drawing tube interfaced with a digitizer tablet and computer. Nomenclature of pinnipeds follows Honacki et al. (1982).

The following ringed seals were examined: Seal 1 was a YOY male weighing 14 kg with a total length of 72 cm; Seal 2 was a YOY female, 18 kg, 79 cm; Seal 3 was a YOY male, 28 kg, 94 cm; Seal 4 was a YOY male, 15 kg, 81 cm; Seal 5 was an adult female, 10 yr old, 30 kg, 110 cm. Parasites found in each of these seals are indicated in Table 1.

Specimens of all helminths were deposited in the Canadian Museum of Nature, Ottawa, Ontario, Canada K1P 6P4 and National Parasite Collection, Beltsville, Maryland, U.S.A. 20705-2350 (Table 1).

We report parasites not previously reported in ringed seals from the eastern Arctic, specifically northern Quebec.

Acanthocheilonema spirocauda (Leidy, 1858) (= *Dipetalonema spirocauda*) (2 males and 3 females) was found in the right ventricle of Seal 2. No gross lesions associated with *A. spirocauda* were observed. This heartworm has been reported from most phocid seals of the Holarctic including ringed seals (Dailey, 1975). It has also been reported from the California sea lion (*Zalophus californianus* (Lesson)) (Taylor et al., 1961).

Table 1. Helminths found in ringed seals collected from Salluit, Quebec.

Helminth	Seal no. infected	Museum specimens deposited*
<i>Acanthocheilonema spirocauda</i>	2	CMNP1993-0050
<i>Otostrongylus circumlitus</i>	1, 2, 4	CMNP1993-0051
<i>Parafilaroides krascheninnikovi</i>	2, 3, 4, 5	CMNP1993-0052
<i>Phocascaris phocae</i>	2, 3, 4	CMNP1993-0043
<i>Corynosoma strumosum</i>	1, 2, 3, 4, 5	CMNP1993-0044 and CMNP1993-0046
<i>Corynosoma reductum</i>	1, 2, 3, 4, 5	CMNP1993-0045 and CMNP1993-0047
<i>Diplogonoporus teptaterus</i>	1, 2, 4, 5	CMNP1993-0048 and CMNP1993-0049
<i>Anophryocephalus</i> sp.	2, 3	CMNP1993-0031 to CMNP1993-0037 USNM82826–82828

* Museum numbers given are inclusive.

The allocation of specimens from the northern fur seal (*Callorhinus ursinus* (Linnaeus)) to *A. spirocauda* are in doubt (see Anderson, 1959; Perry, 1967). The present study is the first report of this parasite in Arctic Canada. The sole report of *A. spirocauda* in Canada is from a captive harbour seal (*Phoca vitulina* Linnaeus) in Nova Scotia (McClelland, 1980). This parasite is known to cause cardiovascular and pulmonary arterial lesions and in severe infections may cause occlusion of arteries (Dunn and Wolke, 1976).

Otostrongylus circumlitus (Railliet, 1899) was present in Seals 1, 2, and 4. Mean intensity (range) of *O. circumlitus* was 34 (7–77). Cephalic extremities of these worms, in right and left lungs, were attached deep in the parenchyma and associated with thick white to yellow mucus. Caudal extremities extended anteriorly within the lumen of bronchioles and bronchi to the trachea. Left and right lungs were equally infected. The sex ratio of female to male worms was 1.8–2.0: 1.0 in Seal 4 and 1, respectively, and 1.0:1.3 in Seal 2. All *O. circumlitus* were adults and females were gravid. This important lungworm has been reported in ringed seal from western Arctic Canada (Onderka, 1989) and from southeastern Baffin Island in eastern Arctic Canada (Smith et al., 1979). The present study confirms the latter report. *Otostrongylus circumlitus*, which has a holarctic distribution, has been reported in other phocids and otariids (Dailey, 1975). This parasite induces extensive pulmonary mucus secretion as

seen in the present study, mucosal hyperplasia, verminous pneumonia, and obliterative bronchitis (Stroud and Dailey, 1978). It has been suggested that *O. circumlitus* may affect health and recruitment of seals. Young-of-the-year seals are infected predominantly (Smith et al., 1979; Onderka, 1989). In the present study only YOY ringed seals were infected. All morphometrics of infected YOY seals ($N = 3$) measured were less than that of the single uninfected YOY seal. For example, infected seals had total body weights 50, 54, and 64% of the total weight of the uninfected seal. In addition, condition indices (body weight/standard length $\times 100$) of the former were less than that of the uninfected YOY seal. In a larger study, Onderka (1989) did not observe a difference in condition factor (axillary girth/standard length $\times 100$) or standard length of infected compared to uninfected ringed seals. "Stunted" ringed seals may also result from pups being born in suboptimum habitat (McLaren, 1958; Finley et al., 1983) or from poor nourishment during lactation and postweaning (Smith, 1987).

Another lungworm, *Filaroides* (*Parafilaroides*) *krascheninnikovi* Yurakhno and Skrjabin, 1971, was found in the lung parenchyma of Seals 2, 3, 4, and 5. Small, white nodules observed in lung parenchyma were associated with this small nematode. Originally reported from ringed seals in the North Pacific Ocean by Yurakhno and Skrjabin (1971), *Parafilaroides krascheninnikovi* has not been reported prior to the present study in seals from eastern North America. However, *Parafilaroides hispidus* Kennedy, 1986 was reported in ringed seal from western Arctic Canada by Onderka (1989). Pathologic lesions associated with species of *Parafilaroides* have been observed in otariids as well as phocids.

Phocascaris phocae Höst, 1932 present in the first 91–122 cm of the small intestine of Seals 2, 3, and 4 had a mean intensity of 32 (3–66). In Seal 4 the intestinal mucosa was eroded in several places where the cephalic extremities of *P. phocae* had been attached. These erosions and 1 group of attached *P. phocae* were aggregated near the beginning of the small intestine. Höst (1932) described mucosal damage of the pyloric wall due to attachment of *P. phocae*. All *P. phocae* were adults except 1, which was in the fourth stage. The sex ratio of female to male worms was 2.0–2.2:1.0. This nematode has a holarctic distribution and has been reported from phocid seals including the ringed seal (see Adams, 1988). In Canada, Lyster (1940) described *P. netsiki* from

ringed seal from eastern Arctic Canada. *Phocascaris* sp. has been reported from ringed seals from eastern Arctic Canada (Myers, 1957a), harp seal (*Phoca groenlandica* Erxleben), and grey seal (*Halichoerus grypus* (Fabricius)) from the south-eastern coast of Atlantic Canada (Myers, 1957b; McClelland, 1980; Bratney and Ni, 1992). Bratney (1990) reported *Phocascaris phocae* in harp seals collected off the coast of Newfoundland. The present study thus confirms the previous reports of *P. phocae* in North America and reports *P. phocae* for the first time in ringed seals from eastern Arctic Canada.

Corynosoma spp. were present in the intestine of all seals. From a random subsample of 130 *Corynosoma* collected (some from all seals), 125 *C. strumosum* (Rudolphi, 1802) and 5 *C. reductum* (von Linstow, 1905) were identified. Most female *C. strumosum* were mature with eggs. Both female *C. reductum* were immature, and no eggs were observed. *Corynosoma strumosum* was found throughout the small and large intestine anterior to the cecum. *Corynosoma reductum* was observed only in the region of the large intestine adjacent and posterior to the cecum and in the rectum. *Corynosoma strumosum* is widespread in pinnipeds including ringed seal (Dailey, 1975). It has been reported in ringed seals from eastern Arctic Canada (Lyster, 1940). *Corynosoma reductum*, however, appears to be restricted to ringed seal and has been reported in ringed seals from Baffin Island (Van Cleave, 1953).

Diplogonoporus tetraapterus (von Siebold, 1848) was found in the intestine of Seals 1, 2, 4, and 5 and *Anophryocephalus* sp. was found in the intestine of Seals 2 and 3. No gross lesions associated with acanthocephalans or cestodes were observed. The former cestode, which is holarctic in distribution, has been reported in otariids and phocids including ringed seal (Markowski, 1952). In Canada it has been reported in Steller sea lions (*Eumetopias jubatus* (Schreber)) from the Pacific coast (Margolis, 1956) and *Diplogonoporus* sp. has been reported in bearded seals and harp seals from the Atlantic coast (Margolis and Arai, 1989). Thus the present study reports *D. tetraapterus* in eastern Canada for the first time.

An examination of the *Anophryocephalus* specimens found in ringed seals in the present study revealed a previously undescribed species, the description of which is to be published elsewhere (Hoberg, pers. comm). *Anophryocephalus anophrys* Baylis, 1922 was reported from a harp seal collected off the coast of Newfoundland

(Smith and Threlfall, 1973) and McClelland (1980) found *Anophryocephalus* sp. in a captive harbour seal in Nova Scotia. The latter report is in doubt (see Hoberg et al., 1991). The infection of the harp seal with *A. anophrys* is considered incidental (Hoberg and Adams, 1992). Species of *Anophryocephalus* presently known from ringed seals are *A. anophrys* and *A. skrjabini* (Krotov and Delyamure, 1955) with *A. anophrys* known from the Subarctic to Arctic of the Atlantic Basin (Hoberg et al., 1991; Hoberg, 1992).

Of the various species of parasites found in the present study only *A. spirocauda* and the lungworms, *O. circumlitus* and *P. krashcheninnikovi*, are likely to be important as etiological agents of disease in seal populations. The lungworms may be important in predisposing seals to secondary lung infections as seen in the bighorn sheep lungworm pneumonia complex (Bergstrom and Honess, 1982; Claussen et al., 1991). Managers of ringed seal populations should be aware that these lungworms may affect survival or recruitment of young seals to local populations. Certainly more data on the importance of these lungworms to ringed seal populations are needed.

We thank the following hunters of Salluit: Bernard Adams, Elijah Thomassiah, Bobby Tayara, Moses Tayara, Issaciek Padlayat, Josie Pauyungie and Kumakuluk Jaaka. We also thank Paul Papigatuk and Makivik Corporation. We appreciate the work of Gary Sleno and Gregor Beck in sectioning and aging seal teeth. J. R. Arthur assisted with the identification of the acanthocephalans and E. Hoberg with the cestodes. We thank M. Kingsley and M. Hammill for reviewing the manuscript. This research was funded through an operating grant to L.M. from the National Engineering and Research Council of Canada and the Department of Fisheries and Oceans.

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Obituary Notice

Robert Jennings Chinnis

died April 12, 1994.

Elected Member December 12, 1984

Executive Board 1987-1988